REVIEWS

Species Diversity in Ecological Communities: Historical and Geographical Perspectives. By R. E. RICKLEFS and D. SCHLUTER. 1994. University of Chicago Press, Chicago. 414 pp.

What are the determinants of species richness in natural communities? This simple question, perhaps above all others, forces ecologists to confront the limits of existing theory and available data. Given the overwhelming role of cryptic and improbable quirks of history, we should find that factorial, linear and deterministic solutions are rare when explaining obvious patterns in distribution and abundance. It is not hard to notice that trees are much more diverse in the tropics than in the temperate zones, as von Humboldt did almost two centuries ago. It is also not hard to suggest a whole laundry list of possible explanations, including differences in climatic stability, productivity, competition and rates of speciation and coevolution. It is hard, however, to go beyond the list and provide synthetic, coherent and realistically detailed explanations, especially when more subtle patterns are elucidated and analyzed. Robert Ricklefs and Dolph Schluter, along with 50 other authors, have gone beyond in this large and important book. They review old and new theory from many schools of ecological thinking, present old and new data on a wide variety of taxa and suggest the need for "a new framework for the study of diversity that emphasizes the use of comparative geographical and historical data to investigate the development of biological communities."

Toward that end, the 30 ensuing papers (including introductory and summary chapters by the editors) are divided into four major groups, reflecting a progression of spatial and temporal scales from the local to the global and from the ecological to the evolutionary. Local ecological processes, such as competition within a single habitat, were once thought only to reduce the number of species over short periods of time. But as G. E. Hutchison suggested, temporal shifts in competitive advantage are common in nature and habitats can be finely partitioned, so that "similar" species may coexist indefinitely. Tilman and Pacala place these ideas within the most modern of contexts, emphasizing demographic, nonequilibrium perspectives that embrace the disproportionate impacts of stochastic processes. Also prominent in this section are linkages between productivity and diversity. Rosenzweig and Abramsky draw some stunning parallels between many types of modern and fossil communities, demonstrating an essentially universal pattern in space and time; diversity rises with low productivities and falls with high productivities. Importantly, they go on to discuss nine hypotheses to explain the pattern, favoring two in the end, but suggesting gaps that need to be filled with new comparative data and experimentation.

The second group of papers links processes between communities that can influence species diversity. At this "mesoscale," dispersal from one community to another (metacommunity dynamics) can allow the persistence of high levels of species richness in much the same way as dispersal between populations (metapopulation dynamics) can allow the persistence of a single species. The approach here is largely theoretical: McLaughlin and Roughgarden review several models that treat dispersal as a diffusion phenomenon influenced by competition or predation within and between collections of species. Extreme rates of dispersal, slow or fast, tend to lower mesoscale diversity, but this is greatly dependent upon environmental heterogeneity. Moderate dispersal rates among communities with patchy habitat structure tend to support larger num-

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bers of species because interactions between species among all patches are less likely to all negative. This "asynchrony" allows interactions for most species to be favorable somewhere in the complex of metacommunities and thus allows for persistence. (Proponents of landscape-level efforts to conserve biological diversity should pay particular attention to these arguments.) Other models are used to explain patterns of distribution and abundance among butterflies and ten additional animal and plant assemblages (Hanksi, Kouki and Halkka), and to experiment with artificial archipelagos whose histories, phyletics and ecology can be perfectly known (Haydon, Radtkey and Pianka). What emerges from these papers is a sense of how far mathematical ecology as come over the last 20 years: model outputs have actually begun to resemble measured or observed attributes in complex communities!

Regional perspectives are covered in the third group of papers. Here, the biotas of entire continents are analyzed with respect to short-term ecological context and long-term geohistorical events. Australian communities figure prominently here, with studies of birds over large-scale transects (Cody) and comparisons with arid zone biotas in North America (Morton). In both cases, the unique history (e.g. faunal exchanges with New Guinea, antiquity of deserts) and strange phylogenetic inheritance (marsupials, Proteaceae, harvester ants) of this continent are shown to influence the patterns of alpha, beta and gamma diversity. Species-area curves even gain some respectability here, with implications for climate change and biological conservation (Westoby). I especially enjoyed the analysis of global mangrove distributions by Ricklefs and Latham, which uses fossil evidence and tectonic reconstruction to explain why the Indo-West Pacific region (including Australia) has four times the number of genera and five times the number of species as the Atlantic-Caribbean-East Pacific region. Its the kind of insightful phytogeography pioneered by R. Good (1947), but thoroughly modernized by dynamic geological and ecological principles.

The large-scale and long-term implications of phylogeny, coevolution and community development are considered in the final group of papers. At this level of analysis, modeling is replaced by cladistics, and species are replaced by guilds or higher taxa. Cornell, for example, examines the evolutionary diversification of insect guilds (e.g., sap feeders, chewing beetles) on common British trees. Surprisingly, life form characteristics of the trees (leaf longevity, palatability) did not appear to influence how many different kinds of insects contributed to guild structure. Instead, taxonomic proliferation of both insects and trees contributes to richness in a guild. *Quercus,* for example, supports excessive numbers of cynipid gall formers, not because of any particular susceptibility of oak tissues, but because both were capable of diversification in addition to coevolution. Even within the genus, the species-rich white oaks have been shown to support larger numbers of leaf miners than the species-poor white oaks. Therefore, the biogeography and history of higher taxa have influenced guild structure more that the observable, ecological features of the organisms themselves. A similar theme emerges from studies of neotropical snakes (Cadle and Greene), temperate zone trees (Latham and Ricklefs), and large North American mammals (Van Valkenburgh and Janis), thus providing support for some of Ricklef's (1987) earlier ideas of how large-scale diversity patterns influence the structure of local communities.

I find it difficult to overstate the impact this book should have on discussions of species diversity among ecologists, graduate students and advanced undergraduates. There is a lot of meat on these bones, much more than I could gnaw off during a first reading. I also think there is much here for conservation biologists, but it is not easy to get at. Most authors stop short of developing the conservation muscles of their findings, which would have been extremely useful at the expense of editorial cohesion and another hundred, bulky pages. Nevertheless, I am left with a sense that community ecology has made some significant advances in recent years, with tremendous potential for enhancing our efforts to preserve biological diversity. This book is an excellent summary and expression of those advances.

References

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—Bruce M. Pavlik, Department of Biology, Mills College, Oakland, CA 94613.

Biological Diversity of Mexico: Origins and Distribution. Edited by T. P. Ramamoorthy, Robert Bye, Antonio Lot and John Fa. 1993. Oxford University Press, New York. xxxix plus 812 pp. Hardcover, $79.95, ISBN 0-19-506674-X.

The introduction of this volume describes Mexico as the only "megadiversity" country, which is also a center of agricultural origin. With about 30,000 plant species, 1000 bird species and more than 2000 fish species, it is timely to compile at least part of the knowledge accumulated on the origin and distribution of the Mexican biodiversity.

This book is the result of a symposium on Biological Diversity of Mexico held in 1988. A large part of the biological community in Mexico and elsewhere joined in this immense effort. Twenty six chapters are divided into six main topics: historical background, description and discussion of selected faunistic groups and floristic groups (these two parts comprising more than half of the book), a section on phytogeography of selected vegetation types, one on plant diversity and humans, and finally, a review of terrestrial habitats. As in any edited book, that includes chapters produced by different authors, there is heterogeneity in quality, depth and subject matter.

The introduction to the book stresses the large number of species in the different groups encountered in Mexico and the urgent need to conserve habitats, by achieving a balance between human needs and the maintenance of biological diversity. The section on historical background starts with a description of the geology of Mexico. For the first time, a physiographic characterization is presented in association with the geologic description of the morphotectonic provinces of Mexico. Although some of the terms used may be too technical for many biologists, this chapter is a valuable source of relevant references on the geology of a particular area. The next chapter on the historical factors and the biological diversity in Mexico is a concise and well-integrated account of the different elements that have contributed to the high diversity in this country. The last chapter in this section discusses the diversity and origins of the phanerogamic flora of Mexico. Rzedowski estimates the total number of angiosperm species to be 21,600 based on the species/genera ratio of the Compositae. Data of local floras show that this ratio has a parallel with the species/genera ratio of the whole phanerogamic flora (in latitudes close to Mexico). Knowing the number of total angiosperm genera in Mexico, the number of species is estimated based on the Compositae species/genera ratio. Although interesting, this empirical relationship between ratios requires at least a hypothetical explanation to convince skeptical readers. The experienced author makes clear that the geographical distribution of endemisms does not follow the same patterns as those of diversity, which is corroborated by the evidence presented in the rest of the book.

The next section presents seven chapters on selected faunistic groups of Mexico. The chapter on native bees of Mexico is noteworthy. It goes beyond a general account of bee distribution and links the biodiversity observed with expected biogeographic patterns. A compilation of all the species recorded in Mexico is followed by a dis-